Chapter 6
UPPER EAST COAST REGION

PHYSICAL CONDITIONS - UPPER EAST COAST REGION

The Upper East Coast Region encompasses approximately 1,139 square miles and includes most of Martin and St. Lucie counties, as well as a portion of eastern Okeechobee County (**Figure 5**). Martin and St. Lucie counties are bounded to the east by the Atlantic Ocean, and Lake Okeechobee borders a substantial portion of Martin County. Urban development is primarily located along the coastal areas while the central and western portions are used primarily for agriculture where the main products are citrus, truck crops, sugarcane and beef and dairy products.

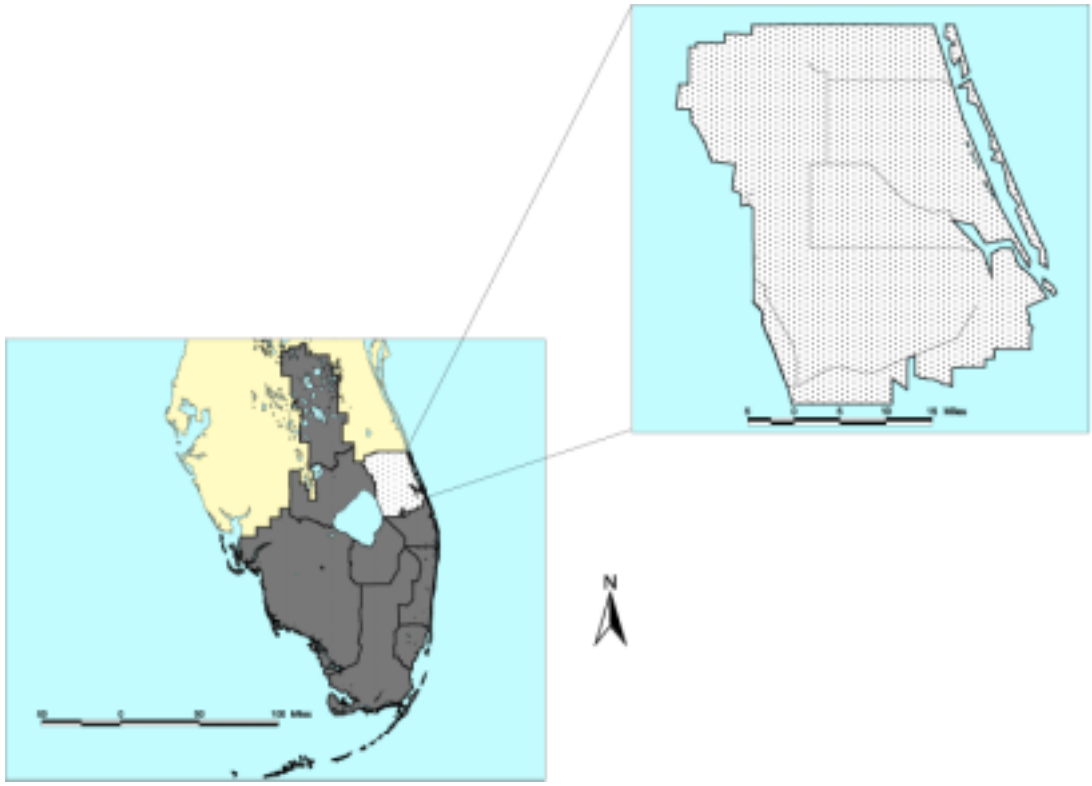

Figure 5. Upper East Coast Region.

The land is generally flat, ranging in elevation from 15 to 60 feet NGVD (National Geodetic Vertical Datum) in the western portion with an average elevation of 28 feet. The coastal area ranges from sea level to 25 feet. The coastal sand hills adjacent to the Atlantic Intracoastal Waterway are higher than most parts of the county and reach a maximum elevation of 60 feet. This feature is known as the Atlantic Coastal Ridge.

The natural drainage has been significantly altered by the construction of canals, drainage ditches and numerous water control structures, which predominately direct storm water discharge to the east coast. The area contains the Central and Southern Florida Flood Control Project (C&SF Project) canals C-23, C-24 and C-25 drainage basins and the drainage area served by C-44 (St. Lucie Canal).

The St. Lucie Canal is Lake Okeechobee's eastern outlet, extending 25.5 miles from Port Mayaca to the city of Stuart, where it terminates at the South Fork of the St. Lucie River. The St. Lucie River Basin is part of a much larger southeastern Florida basin that drains over 8,000 square miles. The St. Lucie River, composed of the North and South forks, lies in Martin and St. Lucie counties in the northeastern portion of the basin. The South Fork is a relatively short stretch of river. The North Fork, designated as an aquatic preserve by the state of Florida, begins south of Fort Pierce and flows past the city of Port St. Lucie to the St. Lucie River Estuary.

The St. Lucie Estuary is part of a larger estuarine system known as the Indian River Lagoon (IRL). The lagoon has been designated an estuary of national significance and is a component of the United States Environmental Protection Agency (USEPA) sponsored National Estuary program. The lagoon is also designated as a state priority water body for protection and restoration under the state's Surface Water Improvement and Management (SWIM) Act. The SWIM plan identifies excessive freshwater runoff from the St. Lucie Estuary Watershed as a problem within the St. Lucie Estuary.

Much of the St. Lucie River has been channelized and many drainage canals empty into the river, particularly the St. Lucie Canal, C-23 and C-24. The St. Lucie Canal, the largest overflow canal for Lake Okeechobee, is a navigation channel 8 feet deep and 100 feet wide connecting the Atlantic Intracoastal Waterway in Stuart with Lake Okeechobee at Port Mayaca.

EXISTING CONDITIONS - UPPER EAST COAST WATER MANAGEMENT

The St. Lucie Estuary is located on the southeast coast of Florida, encompassing portions of both Martin and St. Lucie counties within the watershed. The two forks of the St. Lucie Estuary, the North Fork and South Fork, flow together near the Roosevelt Bridge at the city of Stuart, and then flow eastward approximately 6 miles to the IRL and Atlantic Ocean at the St. Lucie Inlet. Tidal influences in the North Fork reach 15 miles north of Stuart in Five-Mile Creek, and to a water control structure on Ten-Mile Creek just west of the Florida Turnpike at Gordy Road. Tidal influences in the South Fork extend about 8 miles south of Stuart to the St. Lucie Lock and Dam on the St. Lucie Canal. Tidal influence also extends into the extremes of the nearby Old South Fork tributary (Morris, 1987).

The estuary is divided into three major areas, the inner estuary, composed of the North and South forks; the mid-estuary, consisting of the area from the juncture of the North and South forks to Hell's Gate, and the outer estuary extending from Hell's Gate to

the St. Lucie Inlet. The main body of the North Fork is about 4 miles long, with a surface area of approximately 4.5 square miles and a total volume of 998.5 x 10^6 cubic feet at mean sea level. The South Fork is approximately half the size of the North Fork with a surface area of about 1.9 square miles and a volume of 468.7 x 10^6 cubic feet. The mid-estuary extends approximately 5 miles from the Roosevelt Bridge to Hell's Gate and has an area and volume similar to the North Fork (4.7 square miles and 972.7 x 10^6 cubic feet) (Haunert and Startzman, 1985).

Surface sediment composition within the estuary has been mapped by the SFWMD (Haunert, 1988). Sediment composition within the St. Lucie Estuary is influenced by hydrodynamics and is somewhat correlated to depth. Sand substrates, with little organic content, are found along the shallow shorelines of the estuary and in the St. Lucie Canal. This reflects the impacts of wave turbulence and rapid currents. Substrates comprised of mud and moderate quantities of sand are present in areas that are more typically low energy environments, but subjected to occasional high energy events. Mud substrates are found in low energy areas, such as dredged areas and the deeper portions of the estuary. These mud sediments often contain high concentrations of organic materials.

While the estuary encompasses about 8 square miles, the watershed covers an area of almost 775 square miles. The watershed is divided into eight basins; five major basins and three minor ones. Three of these major basins, the C-23, C-24 and C-44, represent basins now linked to the estuary by components of the Central and South Florida Flood Control Project. In addition to drainage from within the C-44 Basin, the C-44 Canal (St. Lucie Canal) also conveys flood control discharges from Lake Okeechobee to the St. Lucie Estuary. The other two major basins, the North Fork, and Tidal Basin, include numerous connections to the St. Lucie Estuary.

Agricultural drainage and residential development have extensively modified the watershed of the entire St. Lucie Estuary. One major effect of these man-made alterations in the landscape and water management practices is increased drainage, manifested by a lowered groundwater table and dramatic changes in how storm water runoff is introduced to the estuary. Typically, when a watershed is highly drained, like the St. Lucie Estuary Watershed, all three runoff factors (quality, quantity and timing) are negatively affected. From a yearly cycle perspective, the quantity of water drained to the estuary is increased, the water quality is degraded and the seasonal distribution of runoff is altered, such that dry season flows are of less magnitude and frequency and wet season flows are of greater magnitude and more frequent. The vast majority of runoff occurs within the first three days after a rainfall event, rather than over an extended period of time. Water quality is degraded, especially by increased amounts of nutrients and suspended solids. The increased nutrients in the St. Lucie Estuary have increased primary productivity within the system to the point where unhealthy levels of dissolved oxygen (DO) occur on a regular basis in the inner estuary.

The dramatic increase in sediment load has contributed significantly to the build-up of muck throughout the system. The sandy sediment loads, like those that build up in the Palm City area, are from primarily high discharge events. However, it is the increased organics coming from high levels of chlorophyll a and floating aquatics, introduced from

the canals combining with highly organic fine suspended sediments that flocculate out at the freshwater-saltwater interface, that lead to the formation of muck. As a result, the benthic environment of the estuary is a favorable habitat for mostly pollution tolerant organisms. In addition, the rapid introduction of freshwater causes salinity fluctuations that are not conducive to developing or maintaining a healthy estuarine plant and animal community. The overall result of these changes is the loss of important habitats.

The St. Lucie Estuary has received increased inflows over the last 100 years because of these modifications to the watershed. Extreme salinity fluctuations and ever-increasing inflows have contributed to major changes in the structure of the communities within the estuary, such as seagrass and oyster losses. Phillips (1961) described the marine plants in the St. Lucie Estuary. At the time, mangroves were abundant in the North and South forks and seagrasses, although stressed, were still found in many areas of the estuary. Today, the presence of seagrasses is severely limited and ephemeral. Oyster populations in the estuary are virtually nonexistent due to the continual exposure to low salinities and lack of suitable substrate (clean hard objects) for larval recolonization (Haunert and Startzman, 1980 and 1985).

Regulatory discharges from the C-44 Canal have been documented to adversely impact the St. Lucie Estuary by depressing the salinity range far below the normal range, and by transporting large quantities of suspended materials into the estuary. Sedimentation problems in relation to C-44 Canal discharges were recognized as early as the 1950's (Gunter and Hall, 1963). While current monthly average flows from the watershed to the St. Lucie Estuary seldom exceed 2,500 cubic feet per second (cfs), regulatory releases from the C-44 Canal alone have produced flows in excess of 7,000 cfs. The quantity of suspended solid material passing Structure S-80 has reached a peak of 8,000 tons a day when daily discharges reached near 7,000 cfs in 1983. Much of this material passes through the estuary and into the IRL or Atlantic Ocean (Haunert, 1988). It was recognized then that these discharges transported sand, as well as very fine, organic rich suspended material to the estuary.

Surface Water Resources

Prior to development, most of the Upper East Coast Planning Area was characterized by nearly level, poorly drained lands subject to frequent flooding. The natural surface drainage systems included large expanses of sloughs and marshes, such as St. Johns Marsh, Allapattah Slough (also referred to as Allapattah Flats) and Cane Slough. Drainage systems with higher conveyance included the North and South forks of the St. Lucie River, Ten Mile Creek, Five Mile Creek, the Loxahatchee River and Bessey Creek. Minor creeks include Danforth, Fraiser, Hidden River, Willoughby, Krueger, Mapps and Warner. Most of these surface water systems, especially those with poor drainage, have been altered to make the land suitable for development and to provide flood control.

Since the early 1900s, numerous water control facilities have been constructed to make this region suitable for agricultural, industrial and residential use. The St. Lucie Canal (C-44) was constructed between 1916 and 1924 to provide an improved outlet for

Lake Okeechobee floodwaters. From 1918 to 1919, the Fort Pierce Farms Drainage District (FPFDD) and the North St. Lucie River Drainage District (NSLRDD) were formed to provide flood control and drainage for citrus production in eastern and northeastern St. Lucie County. The C-25 Canal (also known as Belcher Canal) provided a drainage outlet for the FPFDD, as well as limited flood protection for western areas of the basin. The C-24 Canal (also known as the Diversion Canal) provided drainage and limited flood protection west of the NSLRDD protection levee. The C-23 Canal provided water control in Allapattah Flats during the dry season. However, large areas continued to be under water for months at a time during the wet season.

Although the primary function of the C&SF Project was for flood control and drainage, the drainage network formed by the C&SF Project canals and the secondary canals and ditches has become an important source of irrigation water and frost protection for agriculture. In general, water stored in the canals is replenished by rainfall, groundwater inflow and withdrawals from the Floridan Aquifer System (FAS) when needed.

Prior to the large-scale expansion of citrus in the 1960s, storage in the drainage network in St. Lucie County was adequate to meet irrigation demands. However, the drainage and development of the large marsh areas in western St. Lucie County have depleted much of the surface water storage. The lowering of water tables also reduced the amount of water in groundwater storage. The reduced surface and groundwater storage coupled with increased acreages of citrus have resulted in inadequate supplies of surface water to meet demands during droughts. Therefore, an equitable distribution of the available surface water in the C-23, C-24 and C-25 basins is maintained by limiting the invert elevation of irrigation culverts and the intake elevation of pumps to a minimum of 14.0 feet NGVD. Artesian well water from the FAS is used as an irrigation supplement when surface water supplies become limited. Due to the high mineral content of the Floridan aquifer, this water is generally blended with surface water before it is used as irrigation water.

Surface Water Inflow and Outflow

Within the Upper East Coast Planning Area basins, essentially all surface water inflows and outflows are derived from rainfall. The exception to this is the St. Lucie Canal (C-44), which also receives water from Lake Okeechobee. In addition, most of the flows and stages in the region's canals are regulated for water use and flood protection. The amount of stored water is of critical importance to both the natural ecosystems and the developed areas in the Upper East Coast Planning Area. Management of surface water storage capacity involves balancing two conflicting conditions. When there is little water in storage, drought conditions may occur during periods of insufficient rainfall. Conversely, when storage is at capacity, flooding may occur due to excessive rainfall, especially during the wet season. Management of surface water systems is one of the main factors affecting movement of water through the regional hydrologic cycle.

Groundwater Resources

A distinctive feature of South Florida's hydrologic system is the aquifer system and its use for water supply. Two vast aquifer systems, the Surficial Aquifer System (SAS) and the FAS, underlie the Upper East Coast Planning Area. Groundwater inflows from outside the planning area form an insignificant portion of recharge to the SAS. Rainfall is the main source of recharge, and because of this, long-term utilization of this source must be governed by local and regional recharge rates. The FAS, on the other hand, receives most of its recharge from outside of the Upper East Coast Planning Area. This fact must also be incorporated into long-term planning decisions. Within an individual aquifer, hydraulic properties and water quality may vary both vertically and horizontally. Groundwater supply potential varies greatly from one place to another.

FUTURE WITHOUT PLAN CONDITION - PHYSICAL FACILITIES AND OPERATIONS - CRITICAL RESTORATION PROJECTS

Ten Mile Creek Water Preserve Area

The project is located just south of Ten Mile Creek in St. Lucie County. Ten Mile Creek is the largest subbasin delivering water to the North Fork of the St. Lucie River Estuary (SLE). The SLE discharges into the IRL, which is the most biologically diverse estuary in North America and has been designated as an Outstanding Florida Water. The entire lagoon is endangered due to increased runoff from watershed drainage fluctuations. Excess storm water from drainage improvements is causing radical fluctuations of the salinity of the SLE resulting in elimination of viable habitat suitable for oysters, seagrasses and marine fish spawning.

The project involves acquisition of approximately 920 acres of land and construction of a water preserve area to attenuate flows and improve water quality discharge to the SLE/IRL. The project features a two-stage detention system consisting of a Water Preserve Area (WPA) and polishing cell. A series of large pumps will deliver water from Ten Mile Creek into the WPA during high water at a rate of 380 cfs. Water will be stored in the 550 acre WPA and then metered out through a 40 cfs spillway into a polishing cell of 134 acres. The deep-water storage cell will allow for storage of up to 5,000 acre-feet. The total estimated project cost is $29.1 million according to the project cooperation agreement entered into by the SFWMD and the USACE on January 7, 2000. More information is available regarding this critical project at www.saj.usace.army.mil/projects/index.html.

FUTURE WITHOUT PLAN CONDITION - WATER QUALITY - UPPER EAST COAST

Several ongoing watershed management/planning programs in the Upper East Coast and IRL area are expected to be completed, which would beneficially affect water

quality conditions in the St. Lucie River and Estuary, IRL and other freshwater water bodies in the area. The SFWMD IRL SWIM team has developed numerous programs and objectives to improve water quality conditions in the area. Many of the water quality remediation activities being implemented by the SWIM plan focus on reducing agricultural pollutant loads in the IRL Watershed and urban/suburban pollutant loads in the rapidly developing coastal region surrounding the St. Lucie Estuary and IRL. Implementation of more environmentally sensitive Lake Okeechobee regulation schedules should also reduce pollutant loading to the St. Lucie Estuary/IRL systems. The IRL National Estuary Program, jointly administered by the USEPA and the state of Florida will also result in water quality improvement activities and a reduction of pollutant loads to the IRL in the future. In summary, as a result of these ongoing watershed management programs, water quality in the Upper East Coast is expected to improve in the future.

WATER QUALITY PROBLEMS AND OPPORTUNITIES - UPPER EAST COAST

The Upper East Coast Region includes Martin and St. Lucie counties and a small portion of Okeechobee County. The principal water body is the IRL, which includes the St. Lucie River. The Upper East Coast is hydrologically connected to the Everglades and Florida Bay ecosystems through the C-44 (St. Lucie) Canal. The IRL is a SWIM priority water body. Most of the Upper East Coast Watershed consists of Class III waters; however, there are small areas of Class II waters (shellfish propagation or harvesting) within the watershed. Class II waters are generally afforded greater protection than Class III waters. Currently, nine locations in the St. Lucie (C-44) Canal, the North and South forks of the St. Lucie River, and several subbasins draining to the IRL are listed by the Florida Department of Environmental Protection (FDEP) on the 1998 303(d) list of impaired water bodies. Pollutants/constituents causing impairment include: low levels of DO, excessive nutrients, high levels of total suspended solids (TSS), high biochemical oxygen demand (BOD), coliform bacteria and mercury (based on fish consumption advisories). There are an additional eight monitoring locations in the southern IRL area also included on the 1998 303(d) list. In addition to the above-listed constituents, copper and turbidity were identified to be causing use impairment at some of the monitoring sites.

Overall, water quality conditions in the Upper East Coast and the IRL are expected to be somewhat improved by 2050, compared to existing conditions. Lake Okeechobee freshwater discharges via the St. Lucie Canal (C-44) alter ambient salinity levels and deliver nutrients and other pollutants contained in Lake Okeechobee water and runoff from localized sources (agricultural and urban) to the estuary. The C-23/C-24/C-25 Canal system in St. Lucie County facilitates drainage to sustain agricultural (primarily citrus groves) and urban development in the vicinity of those canals. Implementation of a different regulation schedule for Lake Okeechobee is also expected to improve water quality conditions in the IRL Estuary by reducing the frequency and volume of freshwater delivered to the estuary. It is also expected that agricultural nonpoint source pollution loads delivered to the estuary via secondary and tertiary canals connected to C&SF Project canals will be reduced compared to existing conditions through the implementation of agricultural best management practices (BMPs) and the conversion of some agricultural

lands to other uses (e.g., conservation, urban/suburban development). The efforts of the IRL Save Our Rivers (SOR) project and St. Lucie County Mosquito Control have significantly improved water quality in the eastern lagoon through the use of mosquito impoundments.

The extent of urbanization in the watershed is expected to increase by 2050. New growth and development in the watershed will be regulated to comply with water quality regulations governing point and nonpoint source discharges; however, the net pollution load contributed to the St. Lucie River and the IRL system from these sources is expected to increase compared to existing conditions. Ongoing and planned pollutant load reduction activities in the Upper East Coast Region should help offset additional pollutant loads expected to occur from future urbanization.

LAND USE

Upper East Coast

The record of human existence in the Upper East Coast Region spans approximately 8,000 years. The lagoon system provided the Indians and early settlers with food, materials for tools and their major means of transportation. In the late 1800s, the IRL Region was already established as a major area of commerce (tourism, fisheries, shipping and agriculture). The lagoon was used for safe harbor and transportation of cargo, especially citrus.

At present, the dominant land use in the basin is agriculture (covering approximately 45 percent of the basin). Agricultural activities include 228,000 acres of (NRCS, 1994). The present urban land use (17 percent of the basin) is concentrated along the coast and the lagoon shorelines. Urban growth is rapidly extending westward, replacing agricultural land. Future land use patterns indicate that this trend will continue as urbanization intensifies along the coast, especially in the southern counties (Swain and Bolohassen, 1987). Present forested uplands and wetlands comprise 11 and 18.8 percent of the basin, respectively.

Agriculture - Upper East Coast

Martin and St. Lucie counties are included in this region. Almost one half million acres are farmed (UFBEBR, 1995). St. Lucie and Martin counties rank first and eighth, respectively, among Florida counties for number of acres of citrus (FASS, 1996b). Although this area is known primarily for its citrus production, many acres are used for pasture land. Farms average 600 acres in size with moderate productivity per acre (UFBEBR, 1995). More than 7,500 people are employed in agricultural production and services with a payroll of approximately $9.5 million (UFBEBR, 1995). The market value of all agricultural products in this region totals approximately $362 million (UFBEBR, 1995). Approximately 200,000 acres are irrigated (UFBEBR, 1995) requiring a dependable water supply. Lake Okeechobee has traditionally been the water source for this region.

ELIGIBLE COMPREHENSIVE EVERGLADES RESTORATION PLAN (CERP) PROJECTS

Indian River Lagoon (IRL)

The Comprehensive Plan includes a series of above-ground basin storage reservoir elements, to control water delivery rates and volumes to the St. Lucie River and Estuary and to enhance water supply for agriculture, along with some water quality improvements. The plan recommended in the Final IRL Feasibility Study includes some of the above-ground storage reservoirs outlined in the Comprehensive Plan, but also includes a series of stormwater treatment areas, natural storage and water quality areas, a muck remediation site and benthic habitat restoration through substrate enhancement. The recommended reservoirs have a planned capacity of 127,170 acre-feet in addition to the stormwater treatment areas and natural storage areas. The nature of the desired benefits in the Indian River Lagoon area, as it relates to CERP, has not changed. The IRL Study recommends a means to achieve the water quality objectives through structural and non-structural components. More detailed information is available at www.evergladesplan.org.